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07/780,455 10/22/91 ASAHINA

M PD-8811FWC

EXAMINER

TSAI, H

SPENSLEY HORN JUBAS & LUBITZ
1880 CENTURY PARK EAST, STE. 500
LOS ANGELES, CA 90067

ART UNIT PAPER NUMBER

1107

36

DATE MAILED: 01/04/93

This is a communication from the examiner in charge of your application.
COMMISSIONER OF PATENTS AND TRADEMARKS

- ☒ This application has been examined ☒ Responsive to communication filed on 11/27/92 ☒ This action is made final.

A shortened statutory period for response to this action is set to expire 3 month(s), 0 days from the date of this letter.
Failure to respond within the period for response will cause the application to become abandoned. 35 U.S.C. 133

Part I THE FOLLOWING ATTACHMENT(S) ARE PART OF THIS ACTION:

- ☒ Notice of References Cited by Examiner, PTO-892.
- ☐ Notice re Patent Drawing, PTO-948.
- ☐ Notice of Art Cited by Applicant, PTO-1449.
- ☐ Notice of informal Patent Application, Form PTO-152.
- ☐ Information on How to Effect Drawing Changes, PTO-1474.
- ☐

Part II SUMMARY OF ACTION

1. ☒ Claims ~~1-24~~ 25-28 are pending in the application.

Of the above, claims _____ are withdrawn from consideration.

2. ☒ Claims 1-24 have been cancelled.

3. ☐ Claims _____ are allowed.

4. ☒ Claims 25-28 are rejected.

5. ☐ Claims _____ are objected to.

6. ☐ Claims _____ are subject to restriction or election requirement.

7. ☒ This application has been filed with informal drawings under 37 C.F.R. 1.85 which are acceptable for examination purposes.

8. ☐ Formal drawings are required in response to this Office action.

9. ☐ The corrected or substitute drawings have been received on _____. Under 37 C.F.R. 1.84 these drawings are ☐ acceptable. ☐ not acceptable (see explanation or Notice re Patent Drawing, PTO-948).

10. ☐ The proposed additional or substitute sheet(s) of drawings, filed on _____ has (have) been ☐ approved by the examiner. ☐ disapproved by the examiner (see explanation).

11. ☐ The proposed drawing correction, filed on _____, has been ☐ approved. ☐ disapproved (see explanation).

12. ☒ Acknowledgment is made of the claim for priority under U.S.C. 119. The certified copy has ☒ been received ☐ not been received
☒ been filed in parent application, serial no. 151361; filed on 2-2-88

13. ☐ Since this application appears to be in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under Ex parte Quayle, 1935 C.D. 11; 453 O.G. 213.

14. ☐ Other

EXAMINER'S ACTION

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Applicant's arguments with respect to claims 25-28 have been considered but are deemed to be moot in view of the new grounds of rejection.

The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

Claims 25-28 are rejected under 35 U.S.C. § 103 as being unpatentable over Hooper et al, newly cited in view of Del Monte, previously cited.

Hooper et al. disclose a method of plating an interconnect metal onto a metal in VLSI devices, which includes :

A) Forming lower conductor structure. Col. 3, lines 21-68 and figs. 1-4. :

1. Providing a silicon substrate 10, having silicon oxide coating 11, contact hole 12, doped semiconductor region 13.

2. Forming metal contact and interconnecting structure 14 of Molybdenum or other refractory metal.

3. Performing electroplating or electroless plating layer 15 overlays the layer 14. Copper or gold or silver alloy or other platable and relatively soft metal can be used for plating layer 15. Col. 6, lines 4-12 and col. 3, lines 34-36.

Alternatively, a masking step can be used by forming a patterned photoresist 28 over oxide layer 26, then a copper or

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platable metal layer 30 may then be plated onto layer 14 which is a metal conductor. Following the plating, the unwanted metal and oxide are removed by a plasma etching process. Col 4, lines 13-27 and figs. 6-7.

4. Layer 16 of tungsten or other refractory metal is applied to the layer 15.

5. A silicide layer 17 may be included in the interface of layer 13 and 14. Col. 3, lines 42-48.

B) Forming an upper or overlying metal layer. Col. 4, lines 41-68 and fig. 5. :

1. Depositing an insulator layer 20 on layer 16.
2. Forming a via 21 in insulator layer 20.
3. Upper level metalization can be Molybdenum 22, copper 23 and tungsten or other metals formed just as lower conductor as in figures 1-3 and as described above.

However, Hooper et al. fail to disclose a thermal treatment on plating material.

Del Monte discloses a method for electroplating or electroless plating over metal layer which includes sintering process (thermal treatment). Col. 11, lines 16-21.

It is also well known to artisan that the required temperature for subsequent metal and/or insulating layer deposition (CVD oxide or nitride deposition temperature is between 450-700 degree C, and metal deposition at elevated

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temperature) after metal plating are sufficient to have thermal treatment on the plating material, thereby, it can cause plating material diffuse into other metals in the multilayer metal structure.

Therefore, it would have been obvious to one of ordinary skill in the art to modify Hooper et al. process with an additional thermal treatment if it is needed because plating material can further diffuse into or mix with the other metal layers in the multilayer conductor structure.

Applicant's argument filed in paper No. 35, Nov. 27, 1992 contends that in "Del Monte, a contact electrode bump 23 is formed by electroplating". However, there is not seen any basis for applicant's narrow interpretation of Del Monte. Since there is nothing in this reference that would preclude the use of the combination of electroplating or electroless plating and metal deposition in forming multilayer metal conductor structure.

Applicant's amendment necessitated the new grounds of rejection. Accordingly, **THIS ACTION IS MADE FINAL**. See M.P.E.P. § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 C.F.R. § 1.136(a).

A SHORTENED STATUTORY PERIOD FOR RESPONSE TO THIS FINAL ACTION IS SET TO EXPIRE THREE MONTHS FROM THE DATE OF THIS

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ACTION. IN THE EVENT A FIRST RESPONSE IS FILED WITHIN TWO MONTHS OF THE MAILING DATE OF THIS FINAL ACTION AND THE ADVISORY ACTION IS NOT MAILED UNTIL AFTER THE END OF THE THREE-MONTH SHORTENED STATUTORY PERIOD, THEN THE SHORTENED STATUTORY PERIOD WILL EXPIRE ON THE DATE THE ADVISORY ACTION IS MAILED, AND ANY EXTENSION FEE PURSUANT TO 37 C.F.R. § 1.136(a) WILL BE CALCULATED FROM THE MAILING DATE OF THE ADVISORY ACTION. IN NO EVENT WILL THE STATUTORY PERIOD FOR RESPONSE EXPIRE LATER THAN SIX MONTHS FROM THE DATE OF THIS FINAL ACTION.

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Brasen et al., cited by applicant, disclose a aluminum layer depositing over an interface layer 11 which is made as a structure of alternating amorphous layer of refractory metal and semiconductor material. The deposited structure was annealed at a temperature of 450-550 degree C. Col. 3, lines 12-47.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to H. Jey Tsai whose telephone number is (703) 308-1374.

Any inquiry of a general nature or relating to the status of this application should be directed to the Group receptionist whose telephone number is (703) 308-0661.

hjt *HJT*
12/18/92

V. Chaudhuri
Vik Chaudhuri
Supervisory Patent Examiner
Patent Examining Group 110